1. A voltage regulator having an input terminal to be coupled to an input voltage source and an output terminal to be coupled to a load, comprising:

a power switch to alternately couple and decouple the input terminal to the output terminal with a variable duty cycle;

a filter disposed between the input terminal and the output terminal to provide a substantially DC voltage at the output terminal;

a sampling circuit to make measurements of an electrical characteristic of the voltage regulator at discrete moments of time; and

a feedback circuit coupled to the sampling circuit and the power switch, the feedback circuit configured to use the measurements to control the duty cycle to maintain the DC voltage substantially constant.

2. The voltage regulator of claim 1, wherein the electrical characteristic is a voltage at the output terminal.

3. The voltage regulator of claim 2, wherein the sampling circuit includes a capacitor, a first sampling switch connecting the capacitor to the output terminal, and a second sampling switch connecting the capacitor to the feedback circuit, so that the measurement is made when the first sampling switch opens, is stored as a charge in the capacitor, and is provided to the feedback circuit when the second sampling switch closes.

4. The voltage regulator of claim 1, wherein the electrical characteristic is a current passing through the filter.

5. The voltage regulator of claim 4, wherein the sampling circuit includes a capacitor, a first sampling switch connecting a first plate of the capacitor to a first terminal of the power switch, a second sampling switch connecting a second plate of the capacitor to a second terminal of the power switch, and a third sampling switch connecting the capacitor to the feedback circuit, so that the measurement is made when the first and second sampling switches open, is stored as a charge in the capacitor, and is provided to the feedback circuit

when the third sampling switch closes

6. The voltage regulator of claim 1, wherein the sampling circuit makes the measurement just prior to the power switch closing.

7. The voltage regulator of claim 1, wherein the sampling circuit makes the measurement just prior to the power switch opening.

8. The voltage regulator of claim 1, wherein the sampling circuit makes a first measurement of the electrical characteristic when the power switch is closed and makes a second measurement of the electrical characteristic when the power switch is open.

9. The voltage regulator of claim 8, wherein the feedback circuit uses an average of the first and second measurements to control the duty cycle.

10. The voltage regulator of claim 1, wherein the sampling circuitry includes a capacitor, a first sampling switch connecting the capacitor to an electrical path between the input terminal and the output terminal, and a second sampling switch connecting the capacitor to the feedback circuit.

11. The voltage regulator of claim 10, wherein the second sampling switch is configured to close when the first sampling switch opens.

12. The voltage regulator of claim 11, wherein the first sampling switch is configured to open just before the power switch closes.

13. The voltage regulator of claim 11, wherein the first sampling switch is configured to open just before the power switch opens.

14. The voltage regulator of claim 10, wherein the power switch is driven by a switching

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voltage waveform and the sampling switches are driven by a sampling voltage waveform, and the voltage regulator further comprises a timing circuit to delay the switching voltage waveform relative to the sampling voltage waveform.

15. The voltage regulator of claim 14, wherein the switching voltage waveform is delayed relative to the sampling voltage waveform by approximately the time constant delay of the sampling circuit.

16. The voltage regulator of claim 1, wherein the feedback circuit generates a control signal, and the voltage regulator further comprises a pulse modulator connected to the feedback circuit and the power switch to set the duty cycle in response to the control signal.

17. The voltage regulator of claim 16, wherein the feedback circuit includes one or more switched-capacitor circuits coupled to the sampling circuit to convert the measurement into a charge and to generate the control signal from the charge.

18. The voltage regulator of claim 16, wherein the feedback circuit includes an analog-to-digital converter (ADC) coupled to the sampling circuit to convert the measurement into a digital signal, and a processor coupled to the ADC to generate the control signal from the digital signal.

19. The voltage regulator of claim 1, wherein the power switch includes a first switch connecting the input terminal to an intermediate terminal and a rectifier connecting the intermediate terminal to ground, and the output filter is connected between the intermediate terminal and the output terminal.

20. The voltage regulator of claim 19, wherein the rectifier is a second switch which connects the intermediate terminal to ground.

21. A voltage regulator having an input terminal to be coupled to an input voltage source

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and an output terminal to be coupled to a load, comprising:

a power switch to alternately couple and decouple the input terminal to the output terminal with a variable duty cycle;

a filter disposed between the switch and the output terminal to provide a substantially DC voltage at the output terminal;

a sampling circuit to make a measurement of a current passing through the output filter, the sampling circuit including a capacitor, a first sampling switch connecting a first plate of the capacitor to a first terminal of the power switch, a second sampling switch connecting a second plate of the capacitor to a second terminal of the power switch, and a third sampling switch connecting the capacitor to a sampling terminal; and

a feedback circuit connected to the sampling terminal and the power switch, the feedback circuit configured to use the measurement to control the duty cycle to maintain the DC voltage at a substantially constant level.

22. A DC-DC converter having an input terminal to be coupled to an input voltage source and an output terminal to be coupled to a load, comprising:

a power switch to alternately couple and decouple the input terminal to the output terminal with a variable duty cycle;

a pulse modulator connected to the power switch to set the duty cycle in response to a control signal;

a filter disposed between the power switch and the output terminal to provide a substantially DC voltage at the output terminal;

a first voltage sampling circuit to measure a first voltage at the output terminal at a first discrete moment of time just prior to the power switch coupling the input terminal to the output terminal;

a second voltage sampling circuit to measure a second voltage at the output terminal at a second discrete moment of time just prior to the power switch decoupling the input terminal from the output terminal;

a first current sampling circuit to measure a first current passing through the filter at the first discrete moment of time;

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a second current sampling circuit to measure a second current passing through the filter at the second discrete moment of time;

a feedback circuit connected to the sampling circuits and the pulse modulator, the feedback circuit configured to use the measured voltages and currents to generate the control signal and maintain the DC voltage at a substantially constant level.